care to avoid excessively poisoning water, i.e. poisoning it to the extent it would be unfit and dangerous for use by humans, cattle, fish and the other desirable marine and bird life. Oils used for larvicidal purposes practically always destroy the utility of a pond or water course for livestock and other animals and marine life while in use and therefore can be used to only a very limited extent.

When larvicides are spread directly on a body of water either as a dust or as an oil they are subject to reduced effectiveness by degradation through hydrolysis, degradation by chemical attack of organic matter, and possible loss as droplets on foliage screening the water.

It has been known in the art to mechanically incorporate larvicides on solid materials such as clay (sp. gr. 2.6), polyvinyl chloride (sp. gr. 1.4) and the like. In these cases the pigments act merely as binders or adsorbents, retaining the toxicant for several days and slowing the loss of toxicant to the water for perhaps 3 or 4 days. The toxicant release mechanism is leaching by the water or gradual dissociation of the binder-toxicant mixture into the water. In another instance polystyrene beads and polystyrene foam spheres have been immersed in liquid larvicide. These forms of carrier have great surface area and adsorb relatively large volumes of larvicide, but the mechanism again is mechanical in nature and the toxicant is not long lived.

Periods in which such treatments are effective are quite limited, even in stagnant water. Ordinary larvicides sprayed into stagnant water in recommended concentrations may be effective for about six to eight weeks. Their effectiveness is much shorter for slowly flowing waters such as the water of typical irrigation ditches. Oiling a pond may be effective for several months. Prior art larvicides have numerous shortcomings which can be summed up by the facts that they tend to sink below the water zone where larvae are active and their toxicant life is too short.

The preferred toxicants used in the elastomeric compositions discussed in this application have been shown in the prior art as being toxic to certain water-spawned organisms.

DESCRIPTION OF INVENTION

According to this invention a floating larvicidal EPDM rubber composition is provided which is particularly effective against the larvae noted but which is not harmful to other fish and animal life in the concentrations suitable for killing larvae, and which provides an unusually long term larvicidal action as compared with the prior art techniques.

The vulcanized EPDM elastomer, containing a larvicidal organic toxicant dissolved therein and compounded and cured to exhibit a specific gravity less than 1.0 and controlled release of the toxicant is a unique class of materials capable of molecular release of the organic toxicant into water at controlled rates thereby making it possible to maintain at the surface of the treated water the lowest lethal larvicidal levels of toxicant over very long periods of time.

The larvicidal EPDM elastomeric compositions of this invention are special rubbery compositions in which both the concentration of larvicidal toxicant dissolved therein, on the one hand, and the proportion of certain types of compounding ingredients and the state of cure or vulcanization on the other, are balanced or adjusted, as to provide, when vulcanized, a rubbery elastic matrix in which the organic toxicant remains appreciably soluble and sufficiently mobile as to diffuse to the surface of the composition at a rate at which it is removed from the surface and which is finite, low and selected for the intended larvicidal application. Such surface toxicant is released to the water environment by molecular release.

Molecular release of toxicant is by far the most efficient system in a statistical and biocidal sense. Prior art methods involve direct application of the pure or merely physically-

diluted forms of toxicants, such as for example, toxicants absorbed in clay granules. Much of the effective agent is released as an aggregate and, statistically, the chance of direct contact of the molecular aggregate with the target pest is low. Much lower concentrations of the same toxicant released over longer periods by the described mechanism puts the released toxicant to work at the desired place in its most active and economical form.

Molecular release of toxicant at low levels by means of these larvicidal EPDM rubbers may permit the use of many organic toxicants of known high larvicidal activity, but which are known to hydrolyze or oxidize or which are easily absorbed or destroyed too rapidly to be useful for the desirable length of time. The EPDM rubber matrix holds the toxicant in solution and protects it from contact with water until after release and, as the larvicidal activity of released material dissipates, the toxicant is quickly renewed from the matrix reservoir and thus a sustained toxicity of the water course is maintained over long periods.

When specific organic phosphorothioate toxicants are used as the toxic compounding agent for these elastomer compositions, the toxic element is only slightly soluble in water but is highly soluble in the vulcanizable EPDM elastomer matrices. The active toxic agent in the elastomeric composition dissolves steadily and progressively but very slowly from the surface of the composition when the particles are floated on water. The actual toxicants eventually dissolved into the infested water from the larvicidal EPDM elastomer compositions have not been positively identified but are believed to be identical to the starting toxic agents.

These larvicidal EPDM rubber compositions are preferably in vulcanized form for use. They may be prepared in a wide variety of shapes and forms depending on the service required. A preferred form is pellets or dusts. Strips may also be floated on the water and even anchored in place if there is a moderate water flow. The pellets, for example, may be considerably smaller and lighter in weight than a kernel of corn. These compositions may be molded also into any configuration or article in accordance with conventional techniques in the rubber manufacturing art. In whatever the form, these compositions are relatively safe and non-toxic to humans and higher animal forms while they are in storage or in shipment to the site of use and they remain stable and effective for indefinite periods of storage. To distribute these larvicides for use, the EPDM compositions are merely dropped onto the pond or other body of water. Being solid and compact, though light weight, the pellets have sufficient force to strike through light foliage to the water surface. Foam particles, such as polystyrene foam pellets, are so light that they can be blocked from water by even light intervening foliage or blown away by the wind. The pellets of the invention do not require any special distribution in the water. The water progressively picks up the toxic agent from the wet surface of the floating elastomer and it, in turn, poisons the larvae.

Conventional destruction of mosquito larvae is usually based upon short time, and hence, massive dosages. Physiological destruction is as well accomplished by exposing the organism to lower dosages for longer periods of time, and one can efficiently utilize relatively smaller amounts of active agent in the water by the method presented herein. Less toxicant pollution results and there is less danger to aquatic life. A body of water treated with these floating larvicides can remain as useful as ever for regular fish and livestock uses. In some cases such water can be safely used for human consumption while being treated.

The preferred class of toxicants for these larvicidal elastomeric compounds is the organic phosphorothioates. The EPDM elastomers are specially compounded to maintain a specific gravity less than one so that pellets or other particles of compounded larvicides will float on the water surface and at the same time to have controlled release of toxicant to the water.